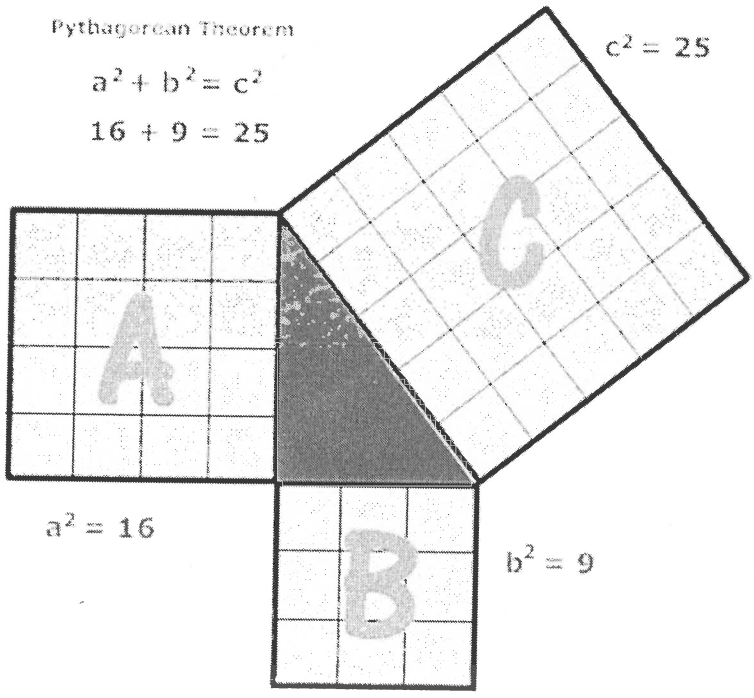
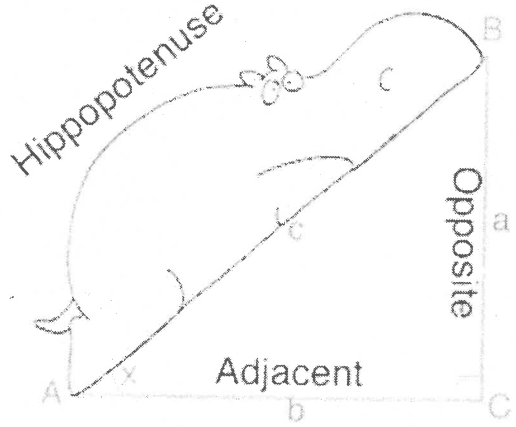
TRIGONOMETRY





filled in

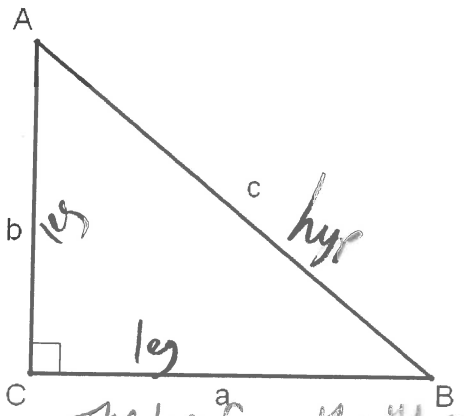
Pythagorean Theorem:

Right Triangle – a triangle with one right angle (or 90°).

Hypotenuse – the longest side of a triangle,

It is always opposite the 90° angle.

Example: side c



Legs – the two sides that intersect to form a right (90°) angle.

Example: sides a and side b.

The legs form the "L"

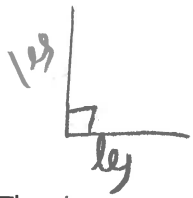
Pythagorean Theorem may be used to determine the length of the sides in right triangles.

Pythagorean Theorem states the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.

$a^2 + b^2 = h^2$

$leg^2 + leg^2 = hyp^2$

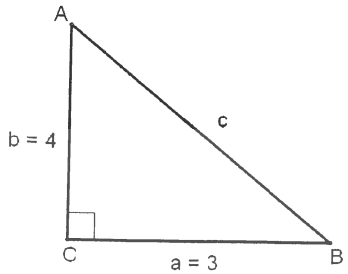
$a^2 + b^2 = c^2$



The *longest* side of the right triangle is typically represented by the letter c.

The two *shorter* sides are typically represented by the letters a and b.

Example 1: ΔABC is a right triangle. If $\angle C = 90°$, a = 3 and b = 4, find side c. (5)



$a^2 + b^2 = c^2$

$3^2 + 4^2 = c^2$

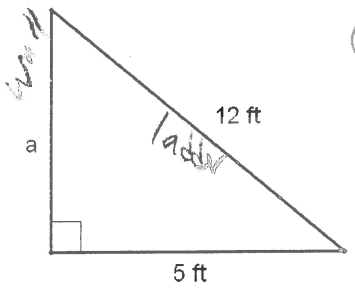
$9 + 16 = c^2$

$\sqrt{25} = \sqrt{c^2}$

$5 = c$

Example 2: A ladder is placed against a wall so that a painter can paint the side of the house. The ladder, the wall, and the ground form a right triangle. If the ladder is 12 feet long and is placed 5 feet from the base of the wall, how high does the ladder reach? 2 decimal places

(10.91)



$a^2 + b^2 = h^2$

$a^2 + 5^2 = 12^2$

$a^2 + 25 = 144$

$-25 \quad -25$

$\sqrt{a^2} = \sqrt{119}$

$a = 10.91 \text{ ft}$

or

$a^2 = h^2 - b^2$

$a^2 = 12^2 - 5^2$

$a^2 = 144 - 25$

$\sqrt{a^2} = \sqrt{119}$

$a = 10.91 \text{ ft}$

Sometimes, the length of the hypotenuse will be given, and you will be required to find the length of one of the legs.

Pythagorean Theorem may be used to determine the length of one of the legs in right triangles.

Pythagorean Theorem may be rewritten to solve for the length of a missing leg.

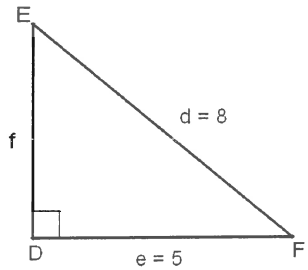
$a^2 = h^2 - b^2$

$leg^2 = hyp^2 - ley^2$

$a^2 = c^2 - b^2$

Example 3: ΔDEF is a right triangle. If $\angle D = 90°$, $d = 8$ and $e = 5$, what is the length of f.

(6.24)



$f^2 = d^2 - e^2$

$f^2 = 8^2 - 5^2$

$f^2 = 64 - 25$

$\sqrt{f^2} = \sqrt{39}$

$f = 6.24$

Pythagorean Practice Questions:

Solve for x. Round answers to 2 decimal places. Show ALL your work!

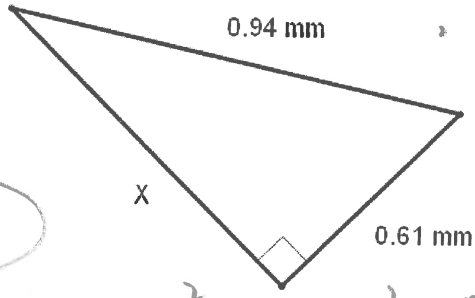
1)

$X^2 = 5.2^2 - 3^2$

$\sqrt{X^2} = \sqrt{18.04}$

$X = 4.25\text{ cm}$

2)

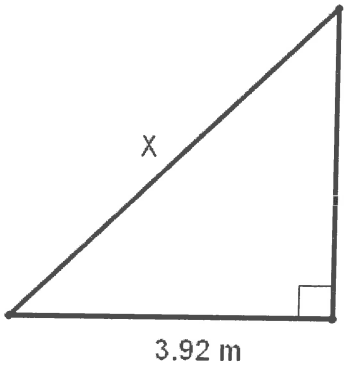


$X^2 = 0.94^2 - 0.61^2$

$X^2 = 0.5115$

$X = 0.72\text{ mm}$

3)

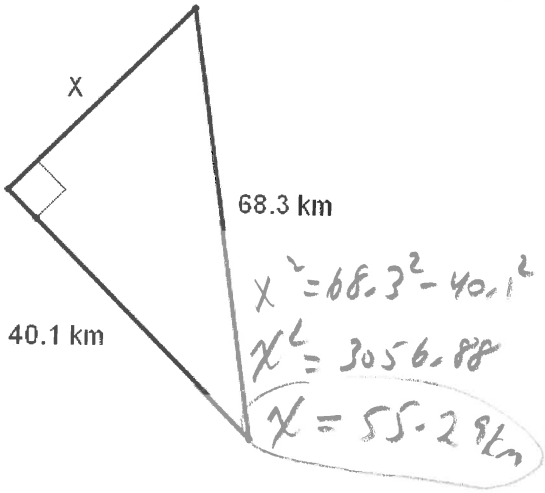


$3.92^2 + 4.90^2 = X^2$

$39.3764 = \sqrt{X^2}$

$6.28\text{m} = X$

4)

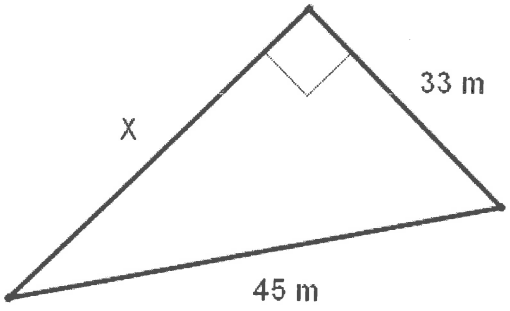


$X^2 = 68.3^2 - 40.1^2$

$X^2 = 3056.88$

$X = 55.29\text{km}$

5)

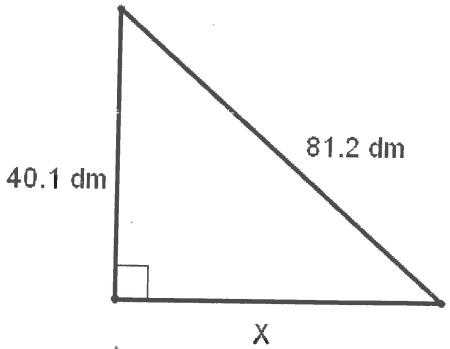


$X^2 = 45^2 - 33^2$

$\sqrt{X^2} = \sqrt{936}$

$X = 30.59\text{ m}$

6)



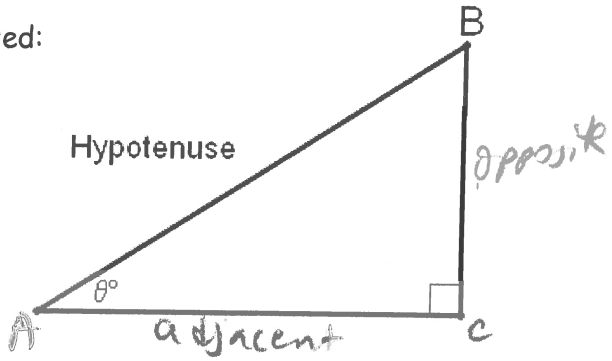
$X^2 = 81.2^2 - 40.1^2$

$\sqrt{X^2} = 4985.43$

$X = 70.61\text{dm}$

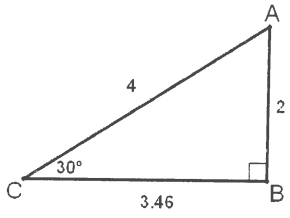
The Trigonometric Ratios:

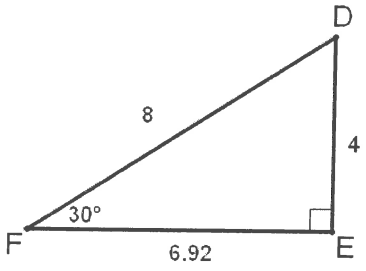
When referring to sides related to an angle, specific words are used:

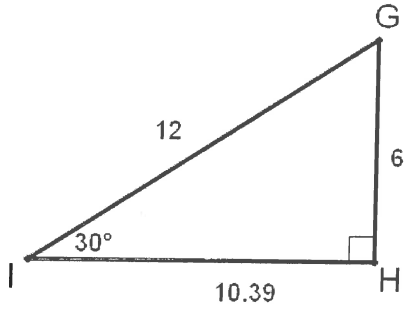


- Side *BC* is said to be opposite $\angle A$ or θ.
- Side *AC* is said to be adjacent (beside or next to) $\angle A$ or θ.
- *AB* is the hypotenuse.

Let's examine some features of triangles. The following three triangles are ***similar.***







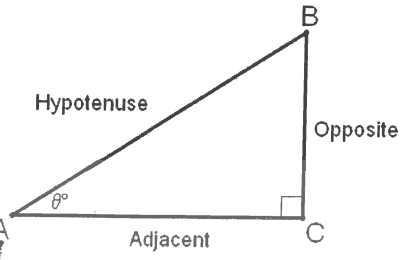
SINE: Notice the ratio of $\frac{\text{length of opposite side}}{\text{length of hypotenuse}}$ for each triangle:

$\frac{AB}{AC} = \frac{2}{4} = \frac{1}{2} = 0.5$ $\quad \frac{DE}{DF} = \frac{4}{8} = \frac{1}{2} = 0.5$ $\quad \frac{GH}{G} = \frac{6}{12} = \frac{1}{2} = 0.5$

Notice that this ratio is always the same.

COSINE: What about the ratio of $\frac{\text{length of adjacent side}}{\text{length of hypotenuse}}$?

Are these also equal? yes



$\frac{BC}{AC} = \frac{3.46}{4} = 0.865$ $\quad \frac{EF}{DF} = \frac{6.92}{8} = 0.865$ $\quad \frac{HI}{GI} = \frac{10.39}{12} = 0.866$

TANGENT: And, what about the ratio of $\frac{\text{length of side}}{\text{length of adjacent side}}$?

$\frac{AB}{BC} = \frac{2}{3.46} = 0.58$ $\frac{DE}{EF} = \frac{4}{6.92} = 0.58$ $\frac{GH}{HI} = \frac{6}{10.39} = 0.58$

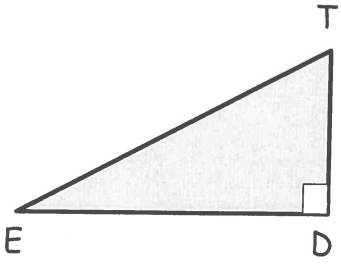
These 3 ratios have been given special names.

THE SINE RATIO - the ratio of the length of the side opposite a given angle to the length of the hypotenuse. (Abbreviation = **sin**)

$\sin\theta = \frac{\text{length of opposite side}}{\text{legnth of hypotenuse}}$ OR $\sin\theta = \frac{opp}{hyp}$

OR $S = \frac{O}{H}$

Example: $\sin E = \frac{TD}{TE}$

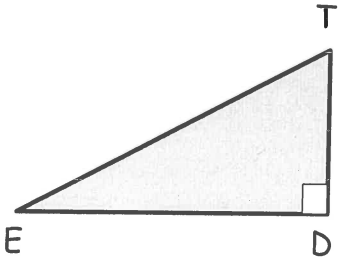


THE COSINE RATIO - the ratio of the length of the side adjacent to a given angle to the length of the hypotenuse. (Abbreviation = **cos**)

$\cos\theta = \frac{\text{length of adjacent side}}{\text{legnth of hypotenuse}}$ OR $\cos\theta = \frac{adj}{hyp}$

OR $C = \frac{a}{h}$

Example: $\cos E = \frac{ED}{TE}$

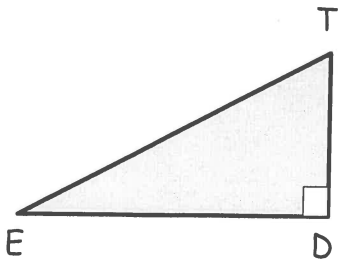


THE TANGENT RATIO - the ratio of the length of the side opposite a given angle to the length of the adjacent side. (Abbreviation = **tan**)

$\tan\theta = \frac{\text{length of opposite side}}{\text{legnth of adjacent side}}$ OR $\tan\theta = \frac{opp}{adj}$

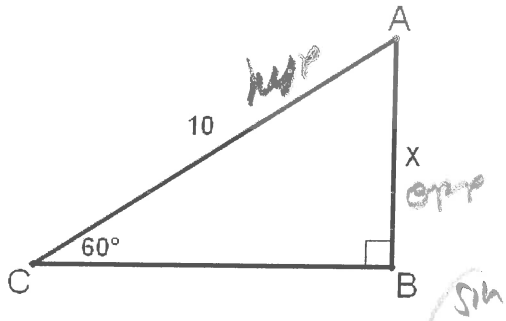
OR $T = \frac{O}{A}$

Example: $\tan E = \frac{TD}{ED}$



How do I remember these 3 ratios? **SOH CAH TOA**

Example 1: Solve for x in the following triangle using the Sin ratio. (8.66)



SOH

$\sin\theta = \frac{O}{h}$

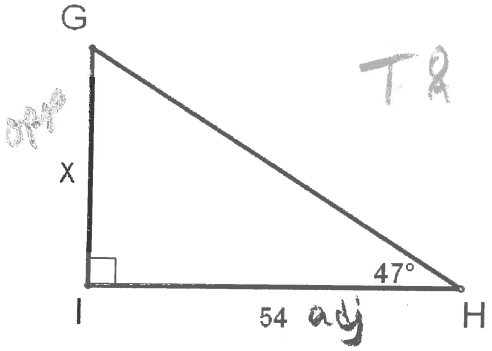
$10(\sin 60) = \left(\frac{x}{10}\right)10$

$10\sin 60 = x$

$8.66 = x$

sin60 then ×10

Example 2: Solve for x in the following triangle using the tan ratio. (57.91)



TOA

$\tan\theta = \frac{O}{A}$

$54(\tan 47) = \left(\frac{x}{54}\right)54$

$54\tan 47 = x$

$57.91 = x$

Example 3: Solve for x in the following triangle using the Cos ratio. (17.20)

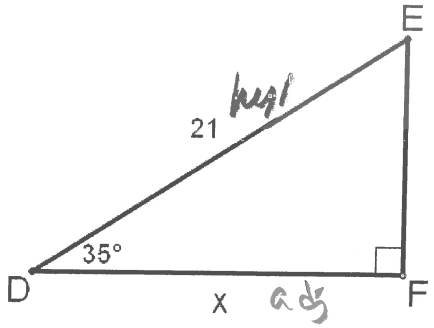
CAH

$\cos\theta = \frac{A}{H}$

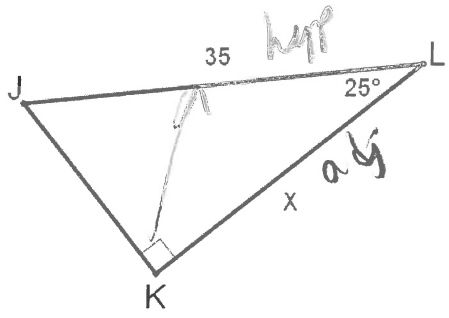
$21(\cos 35) = \left(\frac{x}{21}\right)21$

$21\cos 35 = x$

$17.20 = x$



Example 4: Solve for x in the following triangle. (31.72)



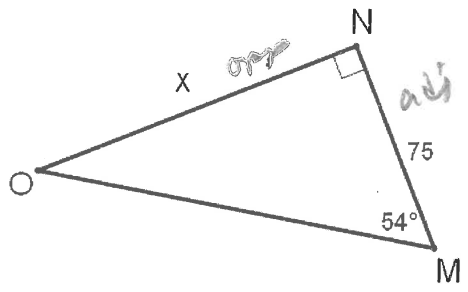
CAH $\quad \cos\theta = \frac{A}{h}$

$\cos 25 = \frac{x}{35}$

$35 \cos 25 = x$

$31.72 = x$

Example 5: Solve for x in the following triangle. (103.23)



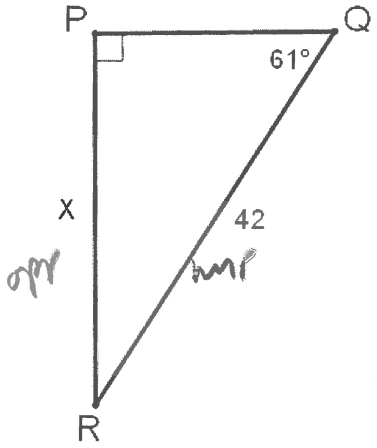
$\tan\theta = \frac{O}{A}$

$\tan 54 = \frac{x}{75}$

$75 \tan 54 = x$

$103.23 = x$

Example 6: Solve for x in the following triangle. (36.73)



$\sin\theta = \frac{O}{h}$

$\sin 61 = \frac{x}{42}$

$42 \sin 61 = x$

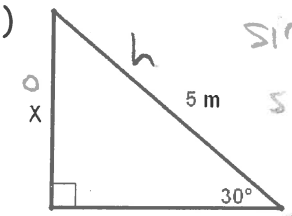
$36.73 = x$

Assignment #1 - Trigonometric Ratios:

Solve for x in the following triangles. Round all answers to 2 decimal places. Show ALL work!

$\sin\theta = \frac{O}{h}$ $\cos\theta = \frac{A}{h}$ $\tan\theta = \frac{O}{A}$ (θ = angle)

1)



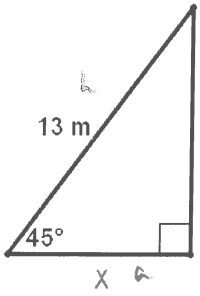
$\sin\theta = \frac{O}{h}$

$\sin 30 = \frac{x}{5}$

$5\sin 30 = x$

$2.5_m = x$

2)



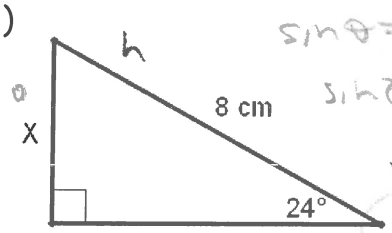
$\cos 45 = \frac{A}{h}$

$\cos 45 = \frac{x}{13}$

$x = 13\cos 45$

$x = 9.19_m$

3)



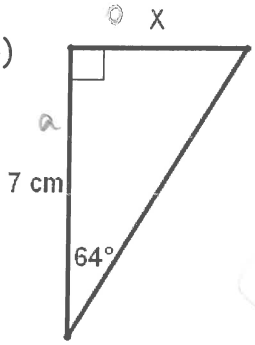
$\sin\theta = \frac{O}{h}$

$\sin 24 = \frac{x}{8}$

$x = 8\sin 24$

$x = 3.25\ cm$

4)



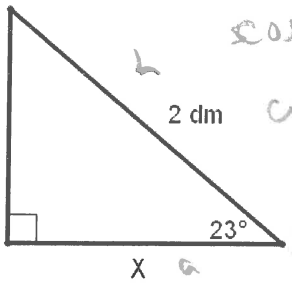
$\tan\theta = \frac{O}{A}$

$\tan 64 = \frac{x}{7}$

$7\tan 64 = x$

$14.35_{cm} = x$

5)



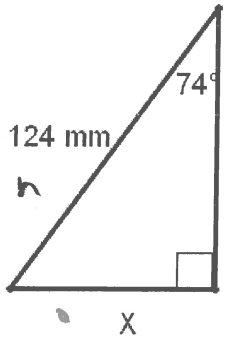
$\cos\theta = \frac{A}{h}$

$\cos 23 = \frac{x}{2}$

$2\cos 23 = x$

$1.84_{dm} = x$

6)



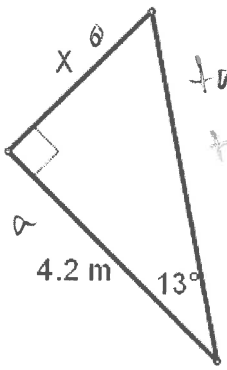
$\sin\theta = \frac{O}{h}$

$\sin 74 = \frac{x}{124}$

$x = 124\sin 74$

$x = 119.20mm$

7)



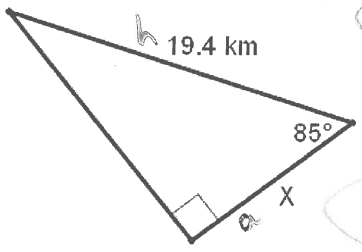
$\tan\theta = \frac{O}{A}$

$\tan 13 = \frac{x}{4.2}$

$4.2\tan 13 = x$

$0.97_m = x$

8)



$\cos\theta = \frac{A}{h}$

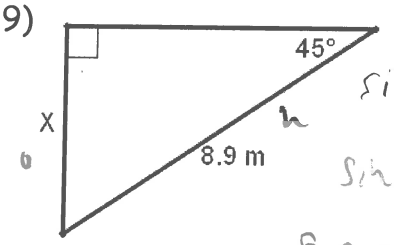
$\cos 85 = \frac{x}{19.4}$

$x = 19.4\cos 85$

$x = 1.69\ km$

extra practice - missing side in numerator.

9)



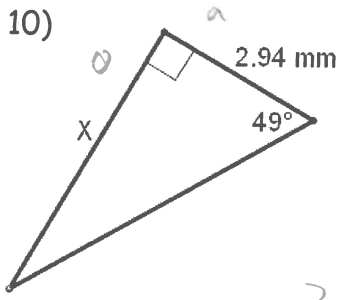
$\sin\theta = \frac{O}{h}$

$\sin 45 = \frac{x}{8.9}$

$8.9 \sin 45 = x$

$6.29_m = x$

10)



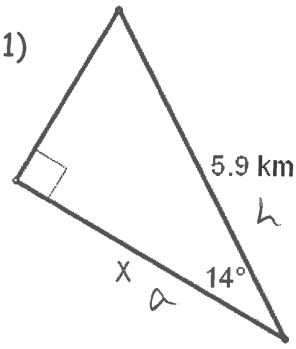
$\tan\theta = \frac{O}{A}$

$\tan 49 = \frac{x}{2.94}$

$2.94 \tan 49 = x$

$3.38_{mm} = x$

11)



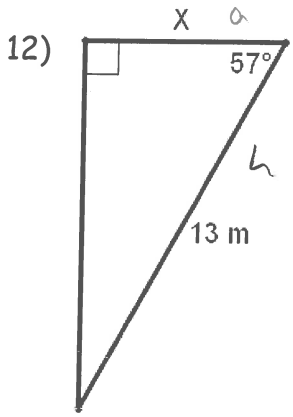
$\cos\theta = \frac{A}{h}$

$\cos 14 = \frac{x}{5.9}$

$5.9 \cos 14 = x$

$5.72_{km} = x$

12)



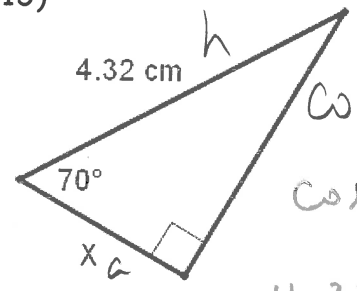
$\cos\theta = \frac{A}{h}$

$\cos 57 = \frac{x}{13}$

$13 \cos 57 = x$

$7.08_m = x$

13)



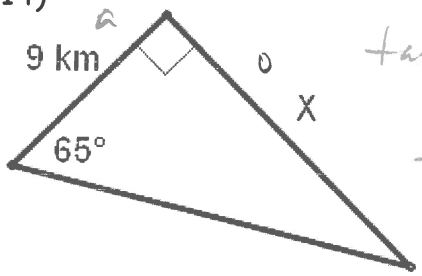
$\cos\theta = \frac{A}{h}$

$\cos 70 = \frac{x}{4.32}$

$4.32 \cos 70 = x$

$1.48_{cm} = x$

14)



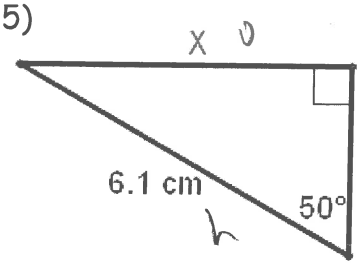
$\tan\theta = \frac{O}{A}$

$\tan 65 = \frac{x}{9}$

$9 \tan 65 = x$

$19.30_{km} = x$

15)



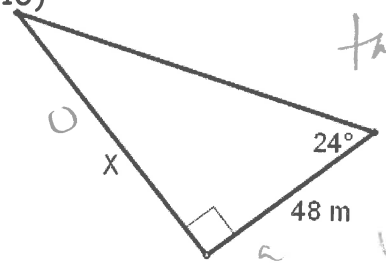
$\sin\theta = \frac{O}{h}$

$\sin 50 = \frac{x}{6.1}$

$6.1 \sin 50 = x$

$4.67_{cm} = x$

16)



$\tan\theta = \frac{O}{A}$

$\tan 24 = \frac{x}{48}$

$48 \tan 24 = x$

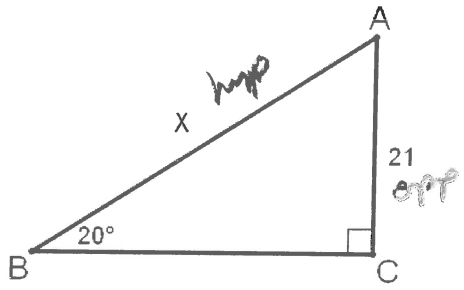
$21.37_m = x$

The Trigonometric Ratios – Part 2:

In all of the previous examples, when we were solving for x, it was in the numerator (top) of the trigonometric ratio.

Now ~~Today~~ we will learn how to solve for x when it is in the denominator (bottom) of the trigonometric ratio.

Example 1: Solve for x in the following triangle. (61.40)



$\sin\theta = \frac{o}{h}$

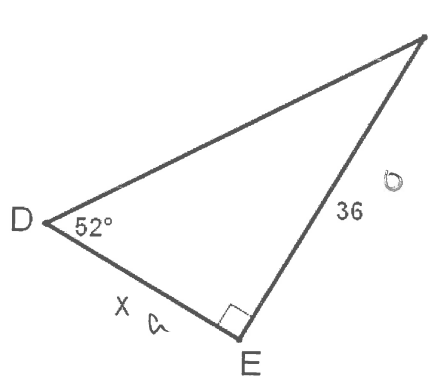
$\sin 20 = \frac{21}{x}$

$\frac{x \sin 20}{\sin 20} = \frac{21}{\sin 20}$

$x = \frac{21}{\sin 20}$

$x = 61.40$

Example 2: Solve for x in the following triangle. (28.13)



$\tan\theta = \frac{o}{a}$

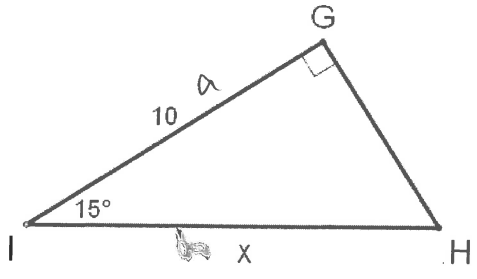
$\tan 52 = \frac{36}{x}$

$\frac{x \tan 52}{\tan 52} = \frac{36}{\tan 52}$

$x = \frac{36}{\tan 52}$

$x = 28.13$

Example 3: Solve for x in the following triangle. (10.35)



$\cos\theta = \frac{a}{h}$

$\cos 15 = \frac{10}{x}$

$x \cos 15 = 10$

$x = \frac{10}{\cos 15}$

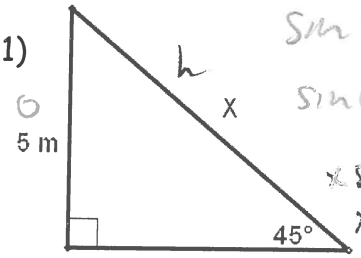
$x = 10.35$

Assignment #2 - Trigonometric Ratios Part 2:

Solve for x in the following triangles. Round all answers to 2 decimal places.

$\sin\theta = \frac{O}{h}$ $\cos\theta = \frac{A}{h}$ $\tan\theta = \frac{O}{A}$ (θ = angle)

1)



$\sin\theta = \frac{O}{h}$

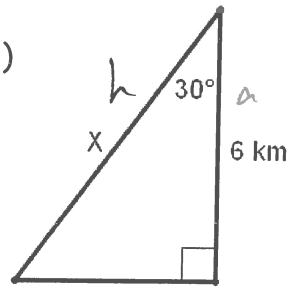
$\sin 45 = \frac{5}{x}$

$x \sin 45 = 5$

$x = \frac{5}{\sin 45}$

$x = 7.07\text{m}$

2)



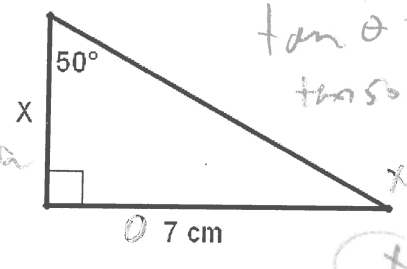
$\cos\theta = \frac{A}{h}$

$\cos 30 = \frac{6}{x}$

$x = \frac{6}{\cos 30}$

$x = 6.93\text{km}$

3)



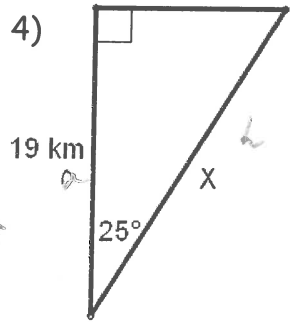
$\tan\theta = \frac{O}{A}$

$\tan 50 = \frac{7}{x}$

$x = \frac{7}{\tan 50}$

$x = 5.87\text{cm}$

4)



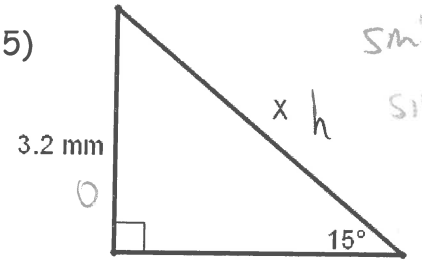
$\cos\theta = \frac{A}{h}$

$\cos 25 = \frac{19}{x}$

$x = \frac{19}{\cos 25}$

$x = 20.96\text{km}$

5)



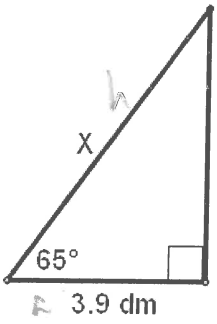
$\sin\theta = \frac{O}{h}$

$\sin 15 = \frac{3.2}{x}$

$x = \frac{3.2}{\sin 15}$

$x = 12.36\text{mm}$

6)



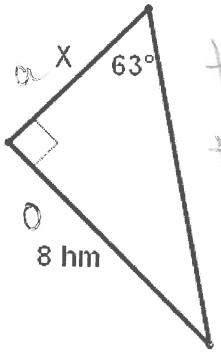
$\cos\theta = \frac{A}{h}$

$\cos 65 = \frac{3.9}{x}$

$x = \frac{3.9}{\cos 65}$

$x = 9.23\text{dm}$

7)



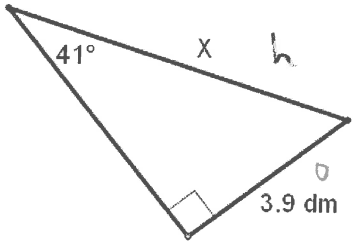
$\tan\theta = \frac{O}{A}$

$\tan 63 = \frac{8}{x}$

$x = \frac{8}{\tan 63}$

$x = 4.08\text{hm}$

8)



$\sin\theta = \frac{O}{h}$

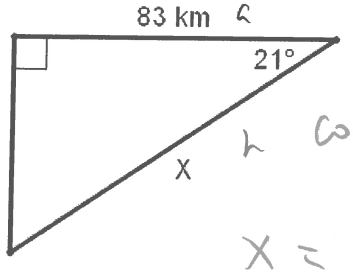
$\sin 41 = \frac{3.9}{x}$

$x = \frac{3.9}{\sin 41}$

$x = 5.94\text{dm}$

#9-14 extra practice – missing side is denom

9)



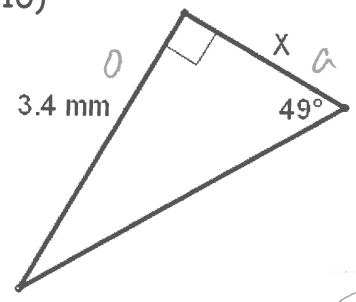
$\cos\theta = \frac{a}{h}$

$\cos 21 = \frac{83}{x}$

$x = \frac{83}{\cos 21}$

$x = 88.9$ km

10)



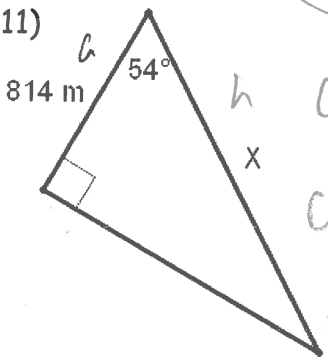
$\tan\theta = \frac{o}{a}$

$\tan 49 = \frac{3.4}{x}$

$x = \frac{3.4}{\tan 49}$

$x = 2.96$ mm

11)



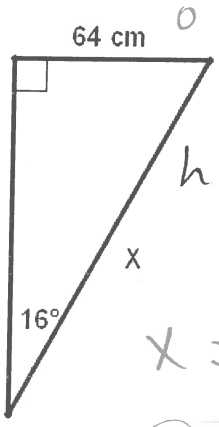
$\cos\theta = \frac{a}{h}$

$\cos 54 = \frac{814}{x}$

$x = \frac{814}{\cos 54}$

$x = 1384.86$ m

12)



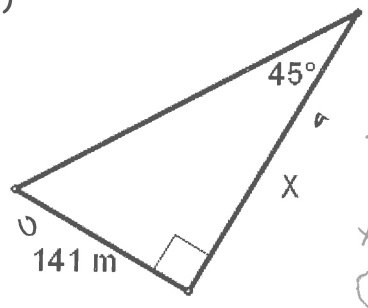
$\sin\theta = \frac{o}{h}$

$\sin 16 = \frac{64}{x}$

$x = \frac{64}{\sin 16}$

$x = 232.19$ cm

13)



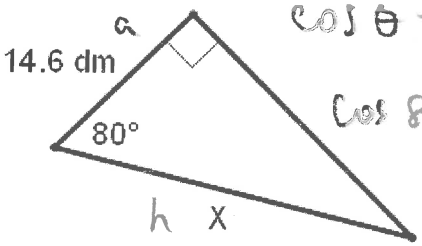
$\tan\theta = \frac{o}{a}$

$\tan 45 = \frac{141}{x}$

$x = \frac{141}{\tan 45}$

$x = 141$ m

14)



$\cos\theta = \frac{a}{h}$

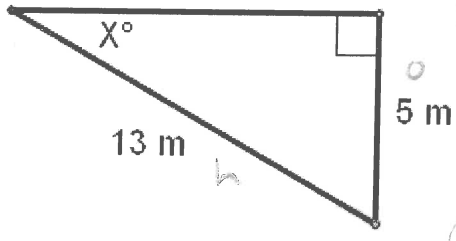
$\cos 80 = \frac{14.6}{x}$

$x = \frac{14.6}{\cos 80}$

$x = 84.08$ dm

Do you remember? Fill in trig ratios as you need. Use inverse of ratio to find any ∠.

15) *



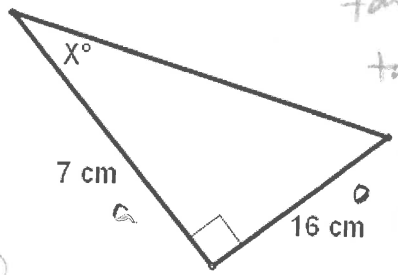
$\sin\theta = \frac{o}{h}$

$\sin x = \frac{5}{13}$

$x = \sin^{-1}\left(\frac{5}{13}\right)$

$x = 22.62°$

16) *



$\tan\theta = \frac{o}{a}$

$\tan x = \frac{16}{7}$

$x = \tan^{-1}\left(\frac{16}{7}\right)$

$x = 66.37°$

The Trigonometric Ratios -Angles: -round to nearest degree

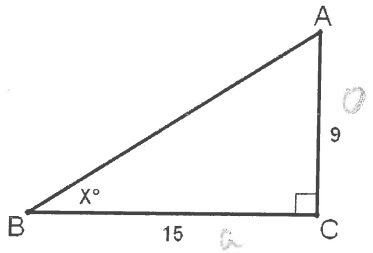
Sometimes, you may need to find the measure of an angle.

To find an angle you must use the "inverse" trigonometric functions on your calculator.

$$\theta = \sin^{-1}\left(\frac{o}{h}\right) \qquad \theta = \cos^{-1}\left(\frac{a}{h}\right) \qquad \theta = \tan^{-1}\left(\frac{o}{a}\right)$$

To do this, you will need to use the "2nd" or "SHIFT" button on your calculator.

Example 1: Solve for x in the following triangle. (30.96°)



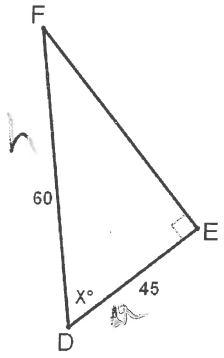
$\tan\theta = \frac{o}{a}$

$\tan x = \frac{9}{15}$

$x = \tan^{-1}\left(\frac{9}{15}\right)$

$x = 31°$

Example 2: Solve for x in the following triangle. (41.41°)



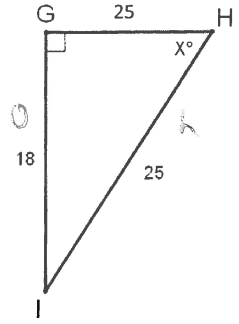
$\cos\theta = \frac{a}{h}$

$\cos x = \frac{45}{60}$

$x = \cos^{-1}\left(\frac{45}{60}\right)$

$x = 41°$

Example 3: Solve for x in the following triangle. (46.05°)



$\sin\theta = \frac{o}{h}$

$\sin x = \frac{18}{25}$

$x = \sin^{-1}\left(\frac{18}{25}\right)$

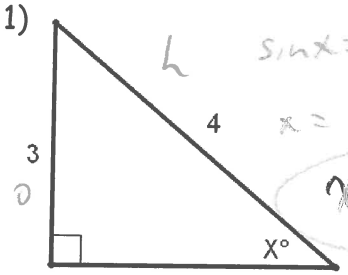
$x = 46°$

Assignment #3 - Trigonometric Ratios - Angles:

Solve for x in the following triangles. Round all answers to the nearest degree.

$\sin\theta = \frac{O}{h}$ $\cos\theta = \frac{a}{h}$ $\tan\theta = \frac{O}{a}$ (θ = angle)

1)



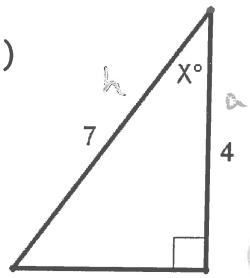
$\sin\theta = \frac{O}{h}$

$\sin x = \frac{3}{4}$

$x = \sin^{-1}\left(\frac{3}{4}\right)$

$x = 49^\circ$

2)



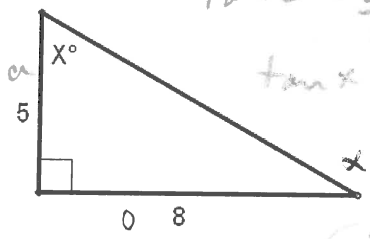
$\cos\theta = \frac{a}{h}$

$\cos x = \frac{4}{7}$

$x = \cos^{-1}\left(\frac{4}{7}\right)$

$x = 55^\circ$

3)



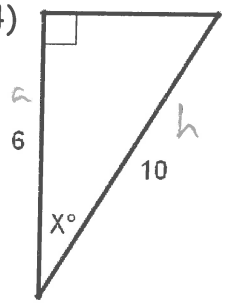
$\tan\theta = \frac{O}{a}$

$\tan x = \frac{8}{5}$

$x = \tan^{-1}\left(\frac{8}{5}\right)$

$x = 58^\circ$

4)



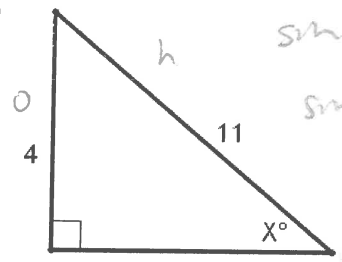
$\cos\theta = \frac{a}{h}$

$\cos x = \frac{6}{10}$

$x = \cos^{-1}\left(\frac{6}{10}\right)$

$x = 53^\circ$

5)



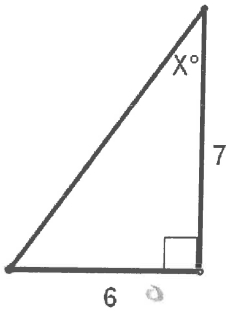
$\sin\theta = \frac{O}{h}$

$\sin x = \frac{4}{11}$

$x = \sin^{-1}\left(\frac{4}{11}\right)$

$x = 21^\circ$

6)



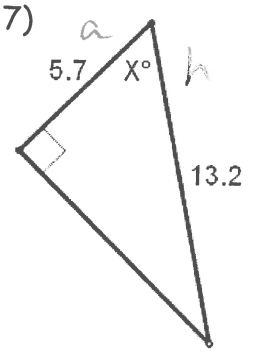
$\tan\theta = \frac{O}{a}$

$\tan x = \frac{6}{7}$

$x = \tan^{-1}\left(\frac{6}{7}\right)$

$x = 41^\circ$

7)



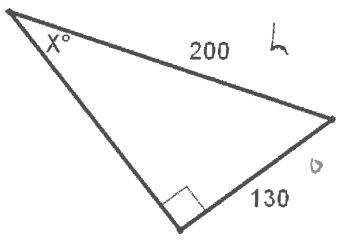
$\cos\theta = \frac{a}{h}$

$\cos x = \frac{5.7}{13.2}$

$x = \cos^{-1}\left(\frac{5.7}{13.2}\right)$

$x = 64^\circ$

8)



$\sin\theta = \frac{O}{h}$

$\sin x = \frac{130}{200}$

$x = \sin^{-1}\left(\frac{130}{200}\right)$

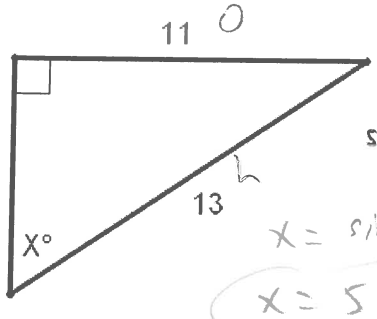
$x = 41^\circ$

round angles to nearest degree
round sides to 2 decimal places

Extra practice - finding angles. 9-14

Do #15, 16

9)



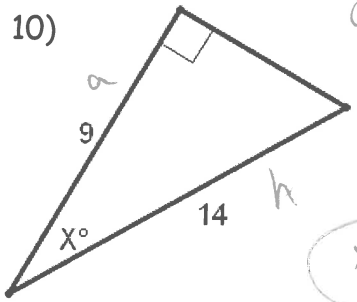
$\sin\theta = \frac{o}{h}$

$\sin x = \frac{11}{13}$

$x = \sin^{-1}\left(\frac{11}{13}\right)$

$x = 58°$

10)



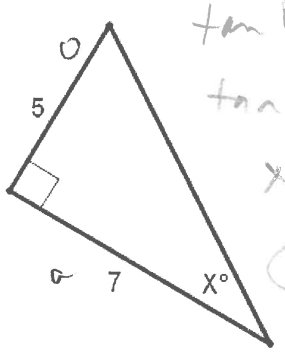
$\cos\theta = \frac{a}{h}$

$\cos x = \frac{9}{14}$

$x = \cos^{-1}\left(\frac{9}{14}\right)$

$x = 50°$

11)



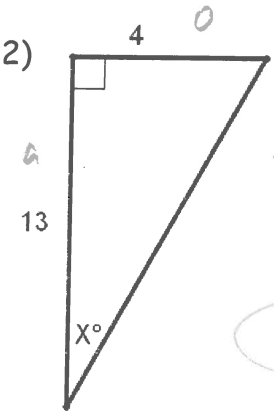
$\tan\theta = \frac{o}{a}$

$\tan x = \frac{5}{7}$

$x = \tan^{-1}\left(\frac{5}{7}\right)$

$x = 36°$

12)



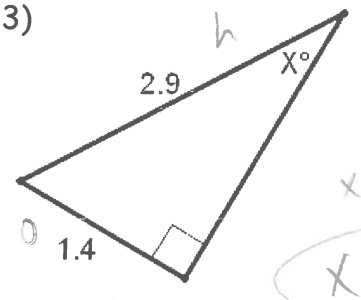
$\tan\theta = \frac{o}{a}$

$\tan x = \frac{4}{13}$

$x = \tan^{-1}\left(\frac{4}{13}\right)$

$x = 17°$

13)



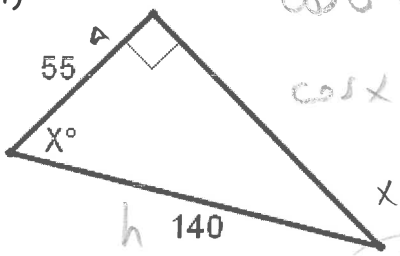
$\sin\theta = \frac{o}{h}$

$\sin x = \frac{1.4}{2.9}$

$x = \sin^{-1}\left(\frac{1.4}{2.9}\right)$

$x = 29°$

14)



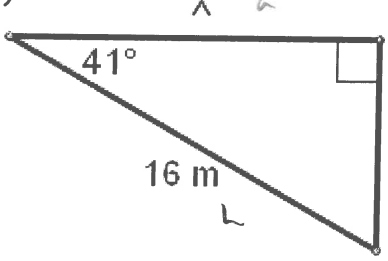
$\cos\theta = \frac{a}{h}$

$\cos x = \frac{55}{140}$

$x = \cos^{-1}\left(\frac{55}{140}\right)$

$x = 67°$

15)



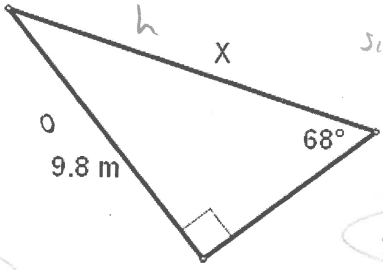
$\cos\theta = \frac{a}{h}$

$\cos 41 = \frac{x}{16}$

$16\cos 41 = x$

$12.08_m = x$

16)



$\sin\theta = \frac{o}{h}$

$\sin 68 = \frac{9.8}{x}$

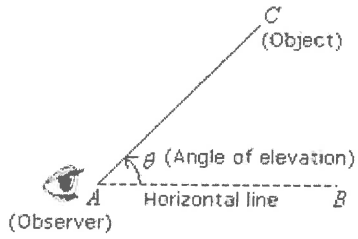
$x = \frac{9.8}{\sin 68}$

$x = 10.57m$

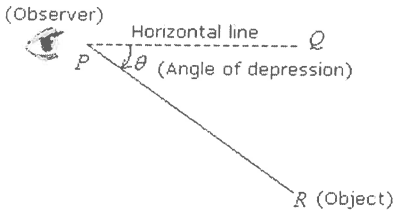
Trigonometry – Word Problems:

Remember:

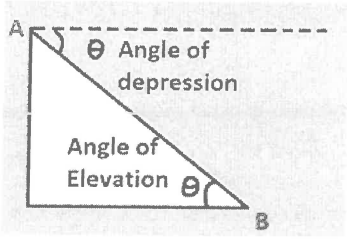
- When solving word problems, make sure to read the problem carefully.
- Making a diagram with labels is always the first step!



Angle of Elevation – the angle formed between the horizontal and the line of sight while looking upward.

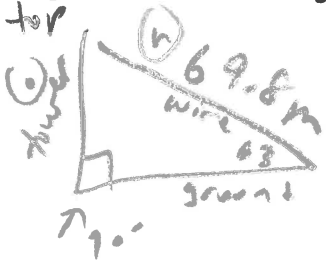


Angle of Depression – the angle formed between the horizontal and the line of sight while looking downward



Note: For any given problem, the angle of elevation will have the same value as the angle of depression.

Example 1: A wire, 69.8 m in length, is attached to the top of a tower. The wire makes an angle of 63° with the ground. How high is the tower, rounded to 2 decimal places? (62.19 m)



$\sin\theta = \frac{o}{h}$

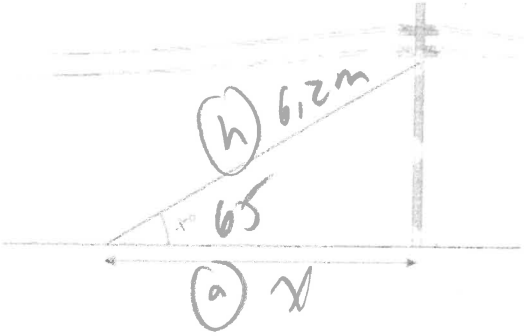
$\sin 63 = \frac{x}{69.8}$

$x = 69.8 \sin 63$

$x = 62.19$

The tower is 62.19 m

Example 2: How far from the base of a pole (rounded to 2 decimal places) must a 6.2 m long guy wire be attached if the angle of elevation is 65°? (2.62 m)



$\cos\theta = \frac{a}{h}$

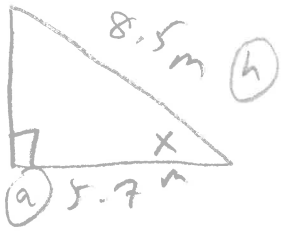
$\cos 65 = \frac{x}{6.2}$

$x = 6.2 \cos 65$

$x = 2.62$

The wire must be attached 2.62 m from the pole.

Example 3: A guy wire 8.5 m long is attached 5.7 m from the base of a pole. Find the angle between the ground and a guy wire. (rounded to nearest degree)



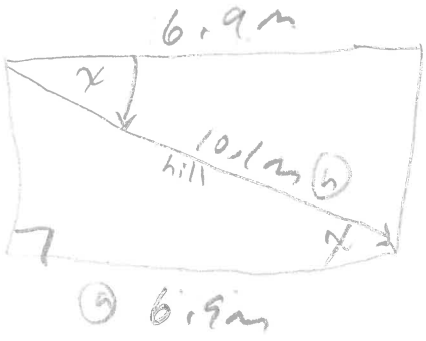
$\cos\theta = \frac{a}{h}$

$\cos x = \frac{5.7}{8.5}$

$x = \cos^{-1}\left(\frac{5.7}{8.5}\right)$

$x = 48°$

Example 4: Find the angle of depression to a point 10.1 m downhill if the horizontal distance is 6.9 m. (rounded to nearest degree)



$\cos\theta = \frac{a}{h}$

$\cos x = \frac{6.9}{10.1}$

$x = \cos^{-1}\left(\frac{6.9}{10.1}\right)$

$x = 47°$

Assignment #4 - Trigonometry Word Problems:

Draw & label diagram. Show trig ratio used, substitute numbers. Write sentence. Round distances to 2 decimal places and angles to nearest degree.

1) The length of the kite string is 86 m. The angle that the string makes with the ground is 36°. Calculate the vertical height of the kite. (51.55 m)

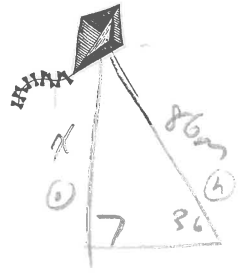
$\sin\theta = \frac{o}{h}$

$\sin 36 = \frac{x}{86}$

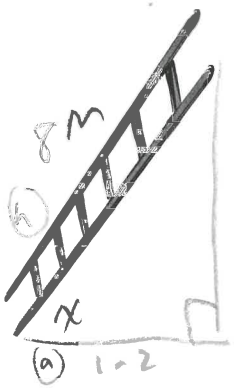
$x = 86 \sin 36$

$x = 51.55$

The height is 51.55 m.



2) An 8 m ladder is leaned against a wall, with the base of the ladder 1.2 m from the wall. Find the angle between the ladder and the ground. (81°)



$\cos\theta = \frac{a}{h}$

$\cos x = \frac{1.2}{8}$

$x = \cos^{-1}\left(\frac{1.2}{8}\right)$

$x = 81°$

The angle is 81°.

3) If the angle of elevation to the top of a tree is 30° from a point 12 m from its base, how tall is the tree? (6.93 m)

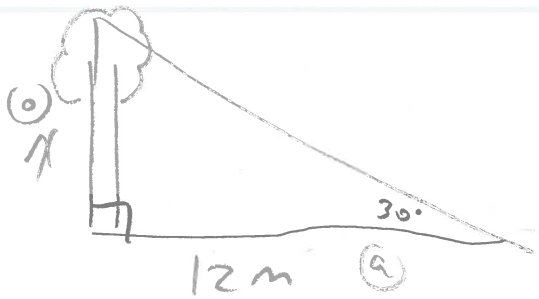
$\tan\theta = \frac{o}{a}$

$\tan 30 = \frac{x}{12}$

$12 \tan 30 = x$

$6.93 = x$

The tree is 6.93 m tall.



4) Lucy must have a wheelchair ramp built to her front porch. The porch is 1.9 m above ground level and the steepest angle of elevation allowed by the building code is 6°.
   a) What is the shortest ramp that Lucy can have installed? (18.2 m) (18.18 m)
   b) About how many metres (to one decimal) from the base of the porch must the ramp start? (18.08 m)

a) $\sin\theta = \frac{o}{h}$

$\sin 6 = \frac{1.9}{x}$

$x = \frac{1.9}{\sin 6}$

$x = 18.18\text{ m}$

18.18 m is the shortest ramp possible.

$1.9^2 + y^2 = 18.18^2$

$y^2 = 18.18^2 - 1.9^2$

$y^2 = 326.902$

$y = 18.08$

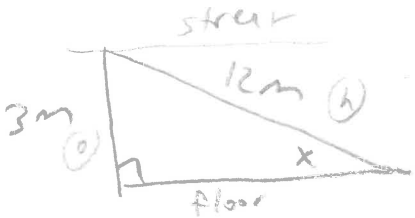
The ramp must start at most 18.08 m from the porch.

(or) b) $\tan\theta = \frac{o}{a}$

$\tan 6 = \frac{1.9}{y}$

$y = \frac{1.9}{\tan 6} = 18.08\text{m}.$

5) The ramp down to an underground garage is 12 m long. If the floor of the garage is 3 m below the level of the street, find the angle of elevation of the ramp.



$\sin\theta = \frac{o}{h}$

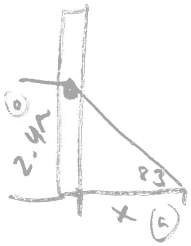
$\sin x = \frac{3}{12}$

$x = \sin^{-1}\left(\frac{3}{12}\right)$

$x = 15^\circ$

The angle of elevation is 15°.

6) A crime scene investigator (CSI) is investigating a bullet hole in the side of a building. The hole is 2.4 m above the floor and entered the wall at an angle of 83°. If the suspect was lying inside the building and on the ground when he took the shot, about how far from the wall was he?



$\tan\theta = \frac{o}{a}$

$\tan 83 = \frac{2.4}{x}$

$x = \frac{2.4}{\tan 83}$

$x = 0.29$

He was about 0.29 m from wall.

Trigonometry Problems – Two Triangles:

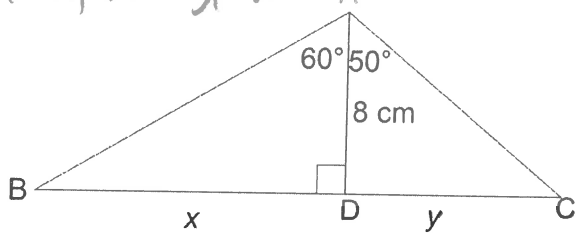
When solving a problem with two triangles, try to identify a common side between the two triangles, or two sides or two angles that you can add.

These types of problems will involve more than one step to answer the question.

Decide what angles and sides you need to find and **label with letters like X, Y, Z.**

Remember to not round off until the final answer. Leave the sides and angles truncated to 4 decimal places. For the final answer, the side can be rounded to 2 decimal places and the angle to the nearest degree.

Example 1: Calculate the length of BC. (23.39 cm) Find x; find y, add together.



(x) $\tan\theta = \frac{o}{a}$

$\tan 60 = \frac{x}{8}$

$x = 8\tan 60$

$x = 13.8564$

(y) $\tan\theta = \frac{o}{a}$

$\tan 50 = \frac{y}{8}$

$y = 8\tan 50$

$y = 9.5340$

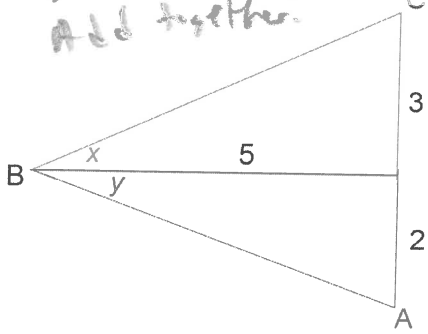
$BC = x + y$

$= 13.8564 + 9.5340$

$BC = 23.39$ cm

Example 2: Calculate the measure of $\angle ABC$. (53°) to nearest degree

Find x. Find y. Add together.



(x) $\tan\theta = \frac{o}{a}$

$\tan x = \frac{3}{5}$

$x = \tan^{-1}\left(\frac{3}{5}\right)$

$x = 30.9637$

(y) $\tan\theta = \frac{o}{a}$

$\tan y = \frac{2}{5}$

$y = \tan^{-1}\left(\frac{2}{5}\right)$

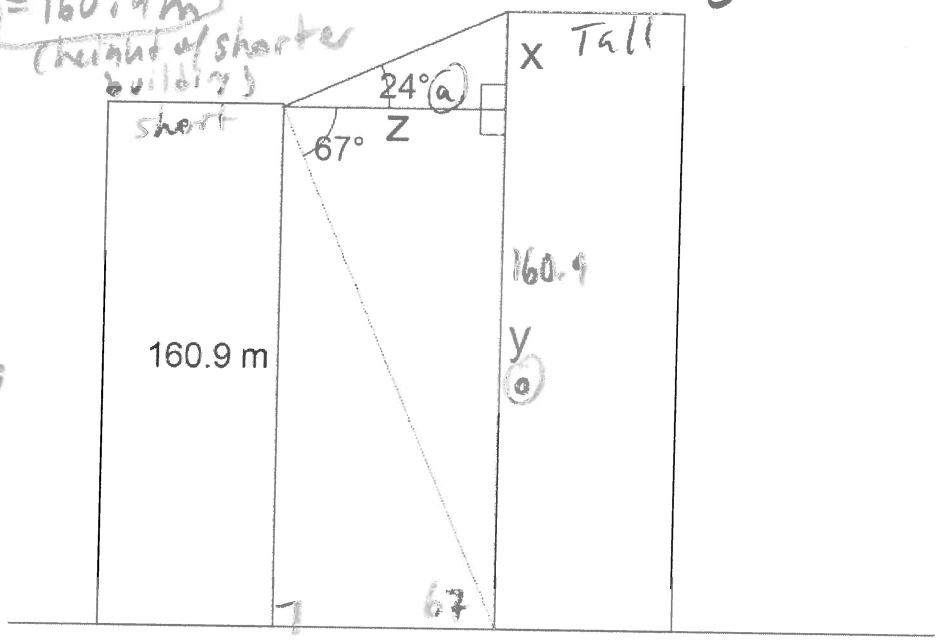
$y = 21.8014$

$\angle ABC = x + y$

$= 30.9637 + 21.8014$

$\angle ABC = 53°$

Example 3: Two office towers are a certain distance apart. The shortest building has a height of 160.9 m. The angle of depression from the top of the shorter tower to the base of the taller tower is 67°. The angle of the elevation from the same point to the top of the taller tower is 24°. What is the height of the taller tower? (19.31 m) → x + y



(Z) $\tan\theta = \frac{o}{a}$

$y = 160.9\ m$ (height of shorter building)

$\tan 67 = \frac{160.9}{Z}$

$Z = \frac{160.9}{\tan 67}$

$Z = 68.2979$

(x) $\tan\theta = \frac{o}{a}$

$\tan 24 = \frac{x}{68.2979}$

$68.2979 \tan 24 = x$

$30.4081 = x$

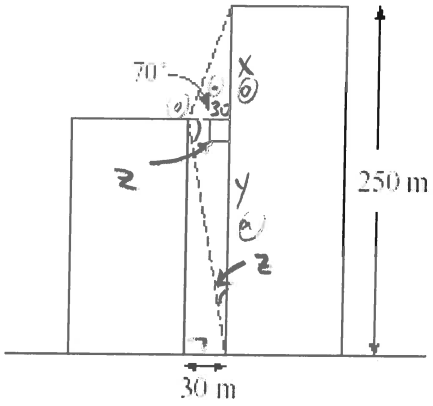
taller tower $= x + y$

$= 30.4081 + 160.9$

taller tower $= 191.31\ m$

Assignment #5 – Word Problems with Two Triangles:

1) Two office towers are 30 m apart. From the top of the shorter tower, the angle of elevation to the top of the other tower, which is 250 m high, is 70°.



a) How much taller is the taller tower? (x)

(truncate 4 decimal places)

$\tan\theta = \frac{o}{a}$

$\tan 70 = \frac{x}{30}$

$x = 30 \tan 70$

$x = 82.4243$

b) Determine the height of the shorter tower. (hint - not using trig) (truncate 4 decimal places)

$y = 250 - 82.4243$

$y = 167.5757\ m$

c) Determine the angle of depression to the base of the taller tower from the top of the shorter tower. (round to nearest degree)

$\tan\theta = \frac{o}{a}$

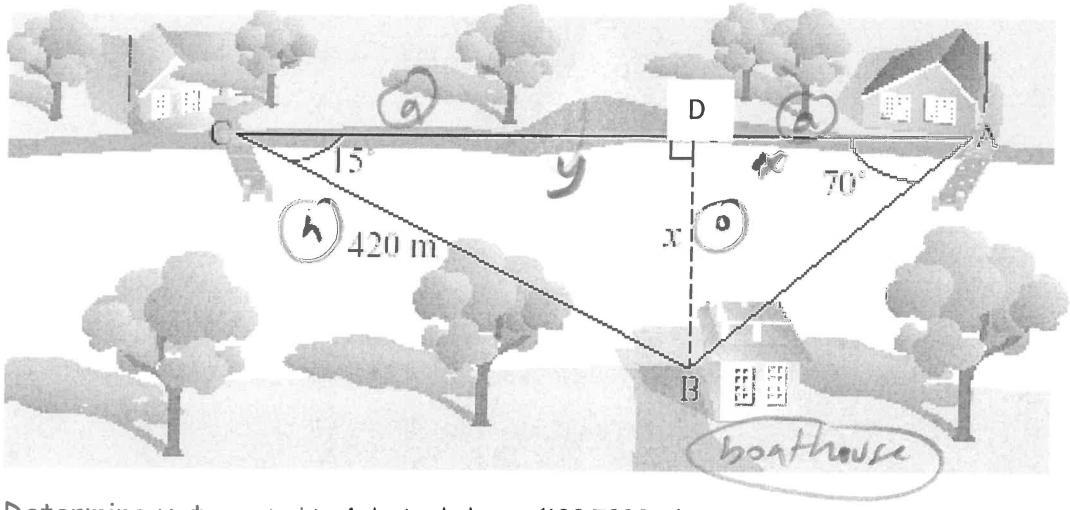
$\tan z = \frac{30}{167.5757}$

$z = \tan^{-1}\left(\frac{30}{167.5757}\right)$

$z = 10°$

The angle is 10°.

2) Two cabins, A and C are located a distance apart on the bank of a river. On the other side of the river from the two cabins is a boathouse, B. It is 420 m from cabin C to the boathouse and the angle at cabin C between the boathouse and cabin A is 15°. From cabin A, the angle between cabin C and the boathouse is 70°.



a) Determine x, truncated to 4 decimal places. (108.7039 m)

$\sin\theta = \frac{o}{h}$

$\sin 15 = \frac{x}{420}$

$420 \sin 15 = x$

$x = 108.7039\text{ m}$

b) Label the distance from C to D as y. Find y, truncated to 4 decimal places. (405.6888m)

$\cos\theta = \frac{a}{h}$

$\cos 15 = \frac{y}{420}$

$420 \cos 15 = y$

$405.6888\text{ m} = y$

c) Label the distance from point D to A as z. Find z, truncated to 4 decimal places. (37.1789 m)

$\cos\theta = \frac{a}{h}$

$\cos 70 = \frac{z}{108.7039}$

$z = 108.7039 \cos 70$

$z = 37.1789\text{ m}$

d) How far apart are the cabins (A to C), rounded to 2 decimal places? (442.87 m) $y+z$

distance $= y + z$

$= 405.6888 + 37.1789$

distance $= 442.87\text{ m}$

The cabins are 442.87 m apart.

3) From a point on the west bank of a river 2 km wide, two speedboats leave for their respective cabins on the east side of the river. The distance to the closer cabin is 3.5 km and the distance to the further cabin is 4.2 km. What is the measure of the angle between the boats' paths?

$\cos\theta = \frac{a}{h}$ $\cos\theta = \frac{a}{h}$

$\cos x = \frac{2}{4.2}$ $\cos y = \frac{2}{3.5}$

$x = \cos^{-1}\left(\frac{2}{4.2}\right)$ $y = \cos^{-1}\left(\frac{2}{3.5}\right)$

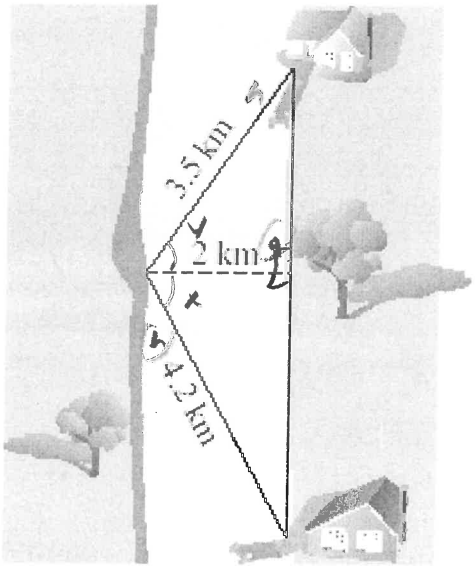
$x = 61.5631$ $y = 55.1500$

$\text{angle} = x + y$

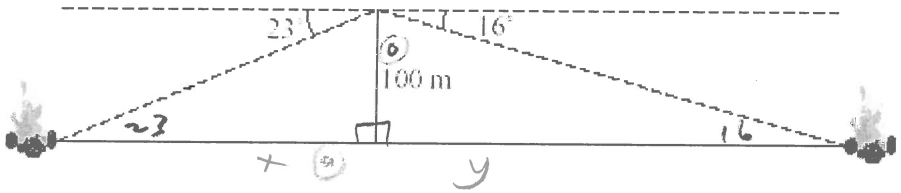
$= 61.5631 + 55.1500$

$\text{angle} = 116.71°$

The angle is 116.71°.



4) From the top of a 100 m tower, a fire ranger spots two fires. One fire is due east of the tower at an angle of depression of 16°. The other is due west and has an angle of depression of 23°. Calculate the distance between the fires.



$\tan\theta = \frac{o}{a}$ $\tan\theta = \frac{o}{a}$

$\tan 23 = \frac{100}{x}$ $\tan 16 = \frac{100}{y}$

$x = \frac{100}{\tan 23}$ $y = \frac{100}{\tan 16}$

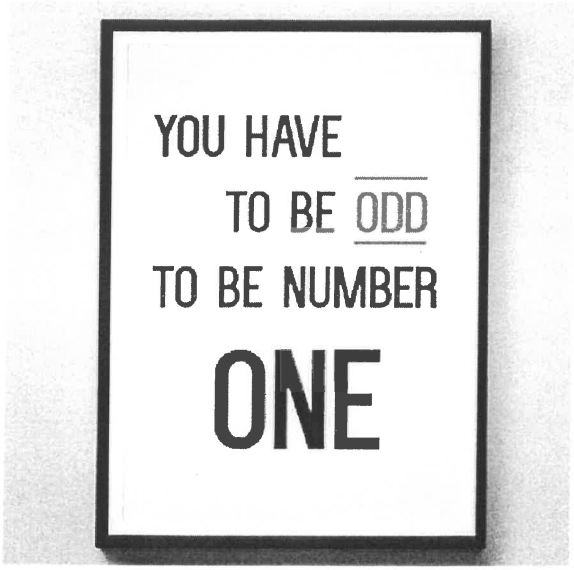
$x = 235.5852$ $y = 348.7414$

$\text{distance} = x + y$

$= 235.5852 + 348.7414$

$\text{distance} = 583.93\text{ m}$

The distance is 583.93m.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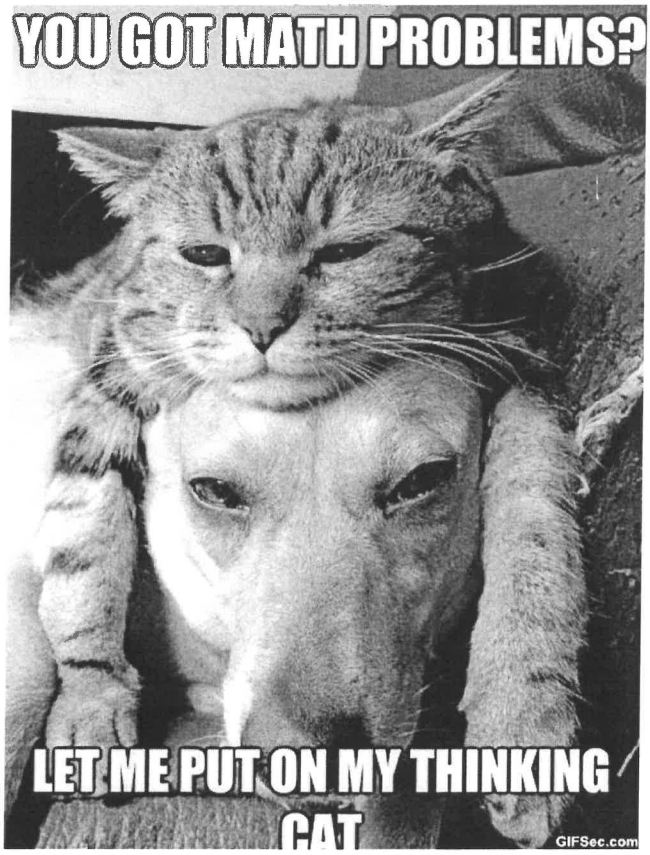
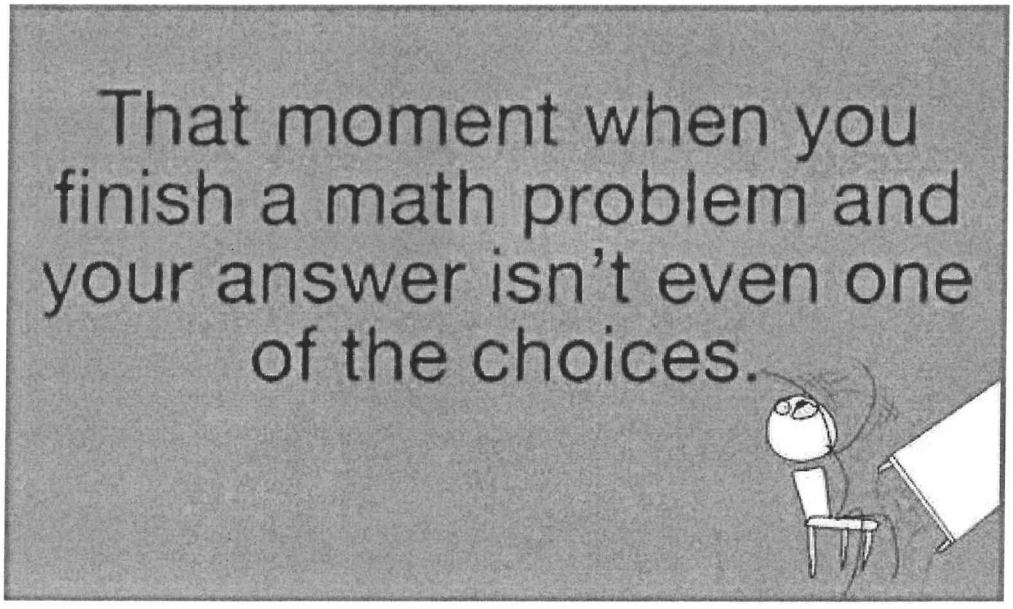

YOU GOT MATH PROBLEMS?
LET ME PUT ON MY THINKING CAT
GIFSec.com


That moment when you finish a math problem and your answer isn't even one of the choices.